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DESCRIPTION

SEQUIN FEEDER APPARATUS

Technical Field

[0001] The present invention relates to sequin feeder apparatus for use in sewing machines which sew a sequin onto a sewing fabric or workpiece while severing the sequin from a ribbon or strip of continuously-connected sequins (continuous sequin strip), and more particularly, it relates to an improved sequin feeder apparatus which can also be appropriately applied to a continuous strip of extremely-small sequins.

Background Art

[0002] Example of the conventional sequin feeder apparatus is known from German Utility Model Registration No. G9209764.2, U.S. Patent No. 5755168 or German Patent No. DE19538084 (corresponding to U.S. Patent No. 5755168). Such a sequin feeder apparatus includes a feed mechanism, which causes a strip of a multiplicity of continuously-connected sequins (spangles) to be played out or let out from a reel, having the continuous sequin strip wound thereon, onto a supporting plate and then, through predetermined forward and rearward (i.e., advancing and retracting) movement of a feed lever, feeds the continuous sequin strip at a predetermined pitch corresponding to the size of each sequin of the strip. One sequin is sewn at a time onto a sewing workpiece while being severed from the continuous sequin strip having been fed in interlocked relation to a sewing operation by a needle bar of the sewing machine.

[0003] In the sequin feeder apparatus, a feed lever feeds the continuous sequin strip by causing its distal end to engage a center hole of a sequin and moving forward or advancing the distal end engaging the center hole, and it then causes the distal end to engage the center hole of a succeeding sequin by moving rearward or retracting the distal end. The supporting plate has a slit that allows the distal of the feed lever to bite into a predetermined sequin in order to more reliably permit engagement between the distal of the feed lever and the sequin. Sequins are severed, one at a time, from the continuous sequin strip by

cooperative operation of a movable cutter blade pivotably provided in proximity to an end of the supporting plate and a fixed cutter blade fixedly provided at the end edge of the supporting plate. After the sewing needle fits in the center hole of the fed-out sequin as the needle bar descends, the movable cutter blade is caused to pivot by being depressed by a needle clamp provided at the lower end of the needle bar.

[0004] Fig. 12 shows a conventionally-known sequin feeder apparatus, where (a) is a side view of the sequin feeder apparatus and (b) is a plan view of the sequin feeder apparatus. Reference numeral 100 indicates the supporting plate, 100a the slit, 100b the fixed cutter blade, 101 the feed lever, 102 the movable cutter blade, 103 the needle bar, 104 the sewing needle, 105 the needle clamp, 106 continuous sequin strip, S the sequin, 106a the center hole of the sequin S, and S1 a connecting portion between the sequins S. With this conventional sequin feeder apparatus, it is not possible to sew a sequin of an extremely small size (e.g., 3 mm diameter). The sequin feeder apparatus is shown in Fig. 12 as used to sew extremely-small sequins of a 3 mm diameter, and the following paragraphs set forth reasons why such extremely-small sequins can not be sewn.

[0005] As seen in (b) of Fig. 12, the feed-out of the sequin S is performed in such a manner that the connecting portion between the leading or first and second sequins S is located in vertical registry with the cutting edge of the fixed cutter blade 100b and that the sewing needle 104 fits into the center hole 106a of the fed-out sequin S. Thus, with the 3 mm diameter sequin, a distance from the cutting edge of the fixed cutter blade 100b to a needle drop position of the sewing needle 104 (indicated by A in (a) of Fig. 12) measures 1.5 mm. Thus, if the needle bar descends from the position shown in (a) of Fig. 12, the tip of the sewing needle 104 will undesirably hit the movable cutter blade 102. As a consequence, it is practically impossible to sew such an extremely-small sequin S.

[0006] Also, the conventional sequin feeder apparatus has the following inconvenience from the viewpoint of the feed mechanism. Namely, in the conventional sequin feeder apparatus, the distal end of the feed lever 101 engages the center hole 106a of the second sequin S from the leading end of the continuous sequin strip 106 when the leading sequin S is to be fed out by advancing movement of the feed lever 101. Thus, in order to feed out a 3 mm diameter

sequin S, there is a need to extend the slit 100a toward the movable cutter blade 102. In fact, however, the slit 100a can not be extended because the hard fixed cutter blade 100 is fixed to an end of the supporting plate 100 adjacent to the movable cutter blade. Thus, for this reason as well, the conventional sequin feeder apparatus can not feed out and sew an extremely-small sequin S.

Disclosure of the Invention

[0007] It is therefore an object of the present invention to provide a sequin feeder apparatus which permits sewing of a continuous sequin strip of extremely-small sequins.

[0008] In order to accomplish the above-mentioned object, the present invention provides a sequin feeder apparatus which comprises: a feed mechanism for feeding a strip of a multiplicity of continuously-connected sequins, let out from a reel and then placed on an upper surface of a supporting plate, at a predetermined pitch corresponding to a size of a sequin of the strip; and a movable cutter blade that cuts off a sequin by being driven downward, by abutment against a needle bar or a member movable with the needle bar, after a sewing needle fits into a hole of a sequin fed out by the feed mechanism as the needle bar descends in accordance with sewing operation of a sewing machine, and which is characterized in that a sequin-cutting portion of the movable cutter blade has a thickness smaller than a thickness of an abutting portion thereof that abuts against the needle bar or the member movable with the needle bar.

For example, the sequin-cutting portion of the movable cutter blade may be formed by reducing the thickness of a region, corresponding to a needle drop position, of the movable cutter blade, and arrangements may be made such that, when the movable cutter blade is in a posture before abutting against the needle bar or the member movable with the needle bar, an upper region of the sequin-cutting portion is located below an uppermost region of the abutting portion not reduced in thickness.

[0009] With the region, corresponding to the needle drop position, of the movable cutter blade having a smaller thickness than the needle bar or the member movable with the needle bar as noted above, the sewing needle can be prevented from hitting the movable cutter blade even where the position of the

sewing needle (i.e., position of the needle bar) is set to be closer to the movable cutter blade than in the prior art. Thus, the sewing needle can be prevented from hitting the movable cutter blade even in sewing of an extremely-small sequin, so that the present invention can sew an extremely-small sequin much smaller in size than those sewn by the prior art. Further, because only the sequin-cutting portion of the movable cutter blade has to be formed into a reduced thickness and the remaining portions of the movable cutter blade may have similar thicknesses to those in the prior art apparatus, a section for mounting the movable cutter blade can be formed into a thickness capable of readily securing a sufficient mounting strength. Namely, the abutting portion of the movable cutter blade, which abuts against the needle bar or the member fixed to the needle bar, may be of the same thickness as the conventional counterpart. Thus, although the needle bar or the member fixed to the needle bar abuts against the abutting portion of the movable cutter blade as the needle bar is driven to descend per stitching, the abutting portion of the movable cutter blade, not reduced in thickness, can easily withstand an abutting impact and thereby prevent breakage of the movable cutter blade.

[0010] Further, in the present invention, the feed mechanism is arranged to feed out a sequin by advancing and retracting movement of a feed lever, and the feed mechanism performs feeding operation by causing the distal end of the feed lever to engage the hole of at least one sequin of the strip on the supporting plate and then advancing the feed lever. Position of the hole where the distal end is to engage when the feed lever is to be advanced is variable in accordance with a size of the sequin.

[0011] With the arrangement that allows the position of the hole, where the distal end is to engage when the feed lever is to be advanced, to be varied depending on the size of the sequin, the feed lever in the present invention can be caused to engage the hole of, for example, a second sequin or third sequin from the leading end of the sequin strip to thereby feed out the sequin. Thus, in sewing an extremely-small sequin, the extremely-small sequin can be fed out by the feed lever being caused to engage the hole of the third sequin from the leading end of the sequin strip, without the slit of the supporting plate having to be extended and without being interfered with by the fixed cutter blade.

[0012] Namely, according to the present invention, only the necessary portion of the movable cutter blade is reduced in thickness so as to retain the necessary mechanical strength of the movable cutter blade, and the movable cutter blade is shaped in a particular manner so that the thickness-reduced portion of the movable cutter blade is located below the non-thickness-reduced abutting portion of the movable cutter blade. Thus, with the thickness-reduced portion of the movable cutter blade, the present invention can achieve the superior benefit that it can appropriately sew a continuous sequin strip of extremely-small sequins as compared to the prior art apparatus.

Brief Description of Drawings

[0013] Fig. 1 is a perspective view showing an outer appearance of an embroidery sewing machine employing a sequin feeder apparatus in accordance with en embodiment of the present invention;

Fig. 2 is a side view showing in an enlarged scale a part of one of sequin sewing units in the embodiment;

Fig. 3 is a side view showing in a further enlarged scale a part of the sequin feeder apparatus employed in the sequin sewing unit in the embodiment;

Fig. 4 is an enlarged perspective view showing, with parts taken away, relevant components of the sequin feeder apparatus of Fig. 3;

Fig. 5 is a partly-sectional side view and schematic plan view of the relevant components of the sequin feeder apparatus, which particularly shows a state of the apparatus when one feeding cycle has been completed with a feed lever moved to its forwardmost position;

Fig. 6 is a partly-sectional side view and schematic plan view of the relevant components of the sequin feeder apparatus, which particularly shows a state of the apparatus immediately after an engaging portion of the feed lever has disengaged from a center hole of a sequin during retracting movement of the feed lever;

Fig. 7 is a partly-sectional side view and schematic plan view of the relevant components of the sequin feeder apparatus, which particularly shows a state of the apparatus when the feed lever has retracted to its rearwardmost position;

Fig. 8 is a partly-sectional side view and schematic plan view of the relevant

components of the sequin feeder apparatus, which particularly shows a state of the apparatus when the engaging portion of the feed lever has engaged the center hole of a sequin during advancing movement of the feed lever;

Fig. 9 is a partly-sectional side view and schematic plan view of the relevant components of the sequin feeder apparatus, which particularly shows a state of the apparatus at a time point when an edge of a through-hole of the feed lever disengages from a lock lever during the forward movement of the feed lever;

Fig. 10 is explanatory of an example operation for feeding an extremely-small sequin and shows relevant components of the sequin feeder apparatus when feed-out of one extremely-small sequin has been completed with the feed lever moved to the forwardmost position, of which (a) is a partly-sectional side view of the relevant components of the sequin feeder apparatus, (b) is a schematic plan view of the relevant components and (c) is a perspective view, with parts taken away, of the relevant components;

Fig. 11 is a partly-sectional side view showing a state of the sequin feeder apparatus immediately before a needle clamp at the lower end of a descending needle bar abuts against a movable cutter blade upon completion of the feeding operation of Fig. 10; and

Fig. 12 is a side view and plan view showing problems presented by a conventionally-known sequin feeder apparatus.

Detailed Description of the Embodiments

[0014] Fig. 1 shows a four-head embroidery sewing machine equipped with four sewing machine heads and employing a sequin feeder apparatus in accordance with an embodiment of the present invention. Needle bar cases 2 are provided in corresponding relation to the sewing machine heads, and a throat plate 50 is disposed under the needle bars of each of the machine head.

[0015] Sequin sewing unit 1 is attached to the left side and/or right side of each of the needle bar cases 2; in the instant embodiment, the sequin sewing unit 1 is attached to only the left side of the associated needle bar case 2. Each of the needle bar cases 2 comprises a multi-needle structure, and, in the case where the sequin sewing unit 1 is attached to only the left side of the associated needle bar case 2 as in the instant embodiment, the leftmost needle in the needle bar case 2

is used as a sequin sewing needle. As conventionally known in the art, an embroidery frame 51 is driven in left-right (X) and front-rear (Y) directions in accordance with sewing data.

[0016] Fig. 2 is a side view showing in an enlarged scale a part of one of the sequin sewing units 1. Fig. 3 is a side view showing in a further enlarged scale a part of a sequin feeder apparatus 6 employed in the sequin sewing unit 1, and Fig. 4 is a perspective view showing, with parts taken away, primary or relevant components of the sequin feeder apparatus 6.

[0017] As illustrated in Fig. 2, the sequin sewing unit 1 also includes a mounting base 4, on which are supported a reel 5, having a continuous sequin strip 3 wound thereon and the sequin feeder apparatus 6. The mounting base 4 is mounted, via a not-shown link mechanism, in such a manner that it can ascend and descend relative to the needle bar case 2. In Figs. 2 and 3, the mounting base 4 is shown as being in a descended position and in a posture ready for sewing of sequins. When sewing of sequins is not to be performed, the mounting base 4 is evacuated to an ascended position so as not to hinder the normal embroidering operation. In the individual machine heads, the mounting bases 4 are driven to ascend or descend concurrently via not-shown air cylinders. Where the embroidery sewing machine has a smaller number of the machine heads like a single-head embroidery sewing machine, the mounting base (or bases) 4 may be caused to ascend or descend manually.

[0018] The reel 5 having the continuous sequin strip 3 wound thereon is rotatably and removably attached to an upper end portion of an arm section 4a formed on an upper portion of the mounting base 4. The continuous sequin strip 3 is formed by die-cutting a synthetic resin film of a given width into a configuration having a multiplicity of circular sequins S continuously connected via connecting portions S1. In the instant embodiment, the continuous sequin strip 3 is a strip of continuously-connected sequins S each having a needle-passing hole (hereinafter referred to as "center hole") 3a (see Fig. 4).

[0019] Next, an example structure of the sequin feeder apparatus 6 will be explained in detail. The sequin feeder apparatus 6 is secured to a support plate 7 that is in turn attached to a lower end portion of the mounting base 4. The support plate 7 has a horizontal supporting plate 8 formed on its lower end for

supporting thereon sequins. Portion of the continuous sequin strip 3, let out from the reel 5, is directed downward along the mounting base 4 via a tension roller 45 and orientation roller 46, led onto the supporting plate 8 by way of a guide section 12 provided on a rear surface of a bracket 11 and then delivered rearward as viewed from the front of the embroidery sewing machine. Note that, in the following description about the sequin sewing unit 1, the terms "forward" and "reward" are used to refer to directions opposite to the forward and rearward directions of the embroidery sewing machine. Namely, the direction in which sequins are fed out (i.e., in a rearward direction as viewed from the front of the embroidery sewing machine) will hereinafter referred to as "forward direction".

[0020] The supporting plate 8 has a slit 8a of a suitable width and predetermined length extending in the front-rear (Y) direction from its front position to its middle position (see (a) of Fig. 5). Through positional adjustment in the left-right (X) direction of the guide section 12, the center hole 3a of each sequin S of the continuous sequin strip 3 can be appropriately positioned in vertical registry with the slit 8a. Namely, the guide section 12 provided on the rear surface of the bracket 11 functions to position the center hole 3a of each sequin S of the continuous sequin strip 3 in vertical registry with the slit 8a; the guide section 12 is never intended to position the continuous sequin strip 3 on a predetermined region of the supporting plate 8. More specifically, the slit 8a of the supporting plate 8 is provided to allow a distal end engaging portion 18a of a feed lever 18 and engaging claw 33a of a lock lever 33 to bite into predetermined sequins S when the distal end engaging portion 18a and engaging claw 33a have engaged the center holes 3a of the sequins S.

[0021] As illustrated in Fig. 3, a pivot shaft 15 is pivotally supported on a middle portion of the support plate 7 with the axial centerline of the pivot shaft 15 extending in the left-right direction (i.e., X direction). Pivot arm or lever 16 is fixed via a screw 17 to the pivot shaft 15, and the feed lever 18 is pivotably supported, via a shaft 19, on a free end portion of the pivot lever 16. Further, a follower lever 20 is fixed via a screw 21 to the pivot shaft 15 adjacent to the pivot lever 16. Consequently, the follower lever 20 and pivot lever 16 are connected together to provide a "bellcrank-like" structure.

[0022] Torsion spring 22 fitted around the pivot shaft 15 has one end

secured to the support plate 7 and the other end held on the follower lever 20. The pivot lever 16 is normally biased in a counterclockwise direction of Fig. 3 by the biasing force of the torsion spring 22. Further, a torsion spring 23 fitted around the shaft 19 has one end secured to the pivot art 16 and the other end held on the feed lever 18, via which the feed lever 18 is normally biased in a clockwise direction. Thus, the engaging portion 18a of the feed lever 18 is normally biased toward the supporting plate 8.

[0023] The feed lever 18 functions to incrementally or sequentially feed the continuous sequin strip 3 in the forward direction at a predetermined pitch, by being moved forward with the engaging portion 18a engaging the center hole 3a of a predetermined sequin S of the strip 3 placed on the supporting plate 8. As will be later detailed, the feed lever 18 is moved forward and rearward in response to pivotal movement of the pivot lever 16, so as to sequentially feed the continuous sequin strip 3 forward at the predetermined pitch. The pivot lever 16 and mechanism for pivoting the pivot lever 16 together constitute a feed mechanism for moving the feed lever 18 forward and rearward. The follower lever 20 integrally connected with the pivot lever 16 has a free end connected to a free end of a driving lever 38 via a connection link 37. The driving lever 38 is fixedly connected to an output shaft 40 of a motor 36 that is in turn secured to a left side surface of the mounting base 4. By the motor 36 driving the driving lever 38 to reciprocatively pivot through a predetermined angular range, the continuous sequin strip 3 can be fed forward in a predetermined manner.

[0024] The pivot art 16 normally biased in the counterclockwise direction is held in a posture as illustrated in Figs. 3, 4 and 5 by abutting against a stopper 25 provided on the support plate 7. The illustrated posture is taken when the feeding of the continuous sequin strip 3 has been completed. (a) of Fig. 5 is a partly-sectional side view showing in an enlarged scale relevant components of the sequin feeder apparatus 6 when one feeding cycle of the continuous sequin strip 3 has been completed, and (b) of Fig. 5 is a schematic plan view of the relevant components of the sequin feeder. Namely, when one feeing cycle of the continuous sequin strip 3 has been completed, the engaging portion 18a of the feed lever 18 has fitted in the center hole 3a of the second sequin S from the leading end of the sequin strip 3, and the connecting portion S1 between the

leading and second sequins S has been positioned immediately above (i.e., in vertical alignment with) the cutting edge of a fixed cutter blade 8b. The stopper 25 is in the form of a threaded rod screwed to a bracket 26 that is in turn secured to the support plate 7, and the pivot lever 16 abuts against the rear end of the stopper 25. The threaded rod can be locked by screwing up of a nut.

[0025] As clearly seen from Figs. 3 and 4, a movable cutter blade 27 is pivotably supported via a pin 28 on a lower end portion of the support plate 7 and is normally held, via a torsion spring 30, in a retracted or evacuated position spaced upward from the fixed cutter blade 8b. The movable cutter blade 27 has a small-thickness distal end portion 27a as a sequin-cutting portion, and this sequin-cutting portion 27a has a smaller thickness than an abutment portion 27b that abuts against the needle clamp 32 descending with the needle bar 31. Namely, an upper region u of the end portion 27a of the movable cutter blade 27 is recessed obliquely downward so that a region of the large-thickness body portion 27b of the blade 27 forms an uppermost portion T of the blade 17 when the movable cutter blade 27 is in its retracted position. The movable cutter blade 27 is depressed by the needle clamp 32, provided at the lower end of the needle bar 31, as the needle bar 31 descends. The depression by the needle clamp 32 causes the movable cutter blade 27 to pivot against the resilient biasing force of the torsion sprint 30, so that the movable cutter blade 27 can cut the strip 3 across the connecting portion S1 of a predetermined sequin S in conjunction with the fixed cutter blade 8b. At that time, the descending needle clamp 32 will come into abutting contact with the large-thickness body portion 27b because the upper region u of the end portion 27a of the movable cutter blade 27 is recessed obliquely downward to allow the large-thickness body portion 27b to become the uppermost portion T. Thus, it is possible to prevent the inconvenience that the descending needle clamp 32 abuts against and damages the small-thickness end portion 27a of a relatively small mechanical strength. As the needle clamp 32 ascends along with the needle bar 31, the movable cutter blade 27 returns to its retraced position by the restoring or resilient force of the torsion spring 30.

[0026] The above-mentioned guide section 12 for directing the continuous sequin strip 3 onto the supporting plate 8 comprises two guide members 12a, each of which may be made by bending a plate into a channel-like sectional shape.

The guide section 12 is replaceable with another one depending on the width of a continuous sequin strip 3 set on the feeder apparatus. Distance between opposed side walls of each of the guide members 12a is set slightly greater than the width of each sequin S of the set strip 3. Holding member 44 is disposed in front of the bracket 11 having the guide section 12 attached thereto. The holding member 44 is in the form of a resilient plate, such as a spring steel plate, which has a width equal to or slightly greater than the width of the sequin S and has a predetermined length. The holding member 44 has one end portion secured to the bracket 11 and the other end portion resiliently abutted against the upper surface of the supporting plate 8, with an intermediate portion of the holding member 44 being bent arcuately. The holding member 44 is recessed in its end portion adjacent to the slit 8a of the supporting plate 8 so as not to close the slit 8a (see Fig. 4). The continuous sequin strip 3, delivered via the guide section 12, is passed between the supporting plate 8 and the holding member 44 resiliently abutted against the upper surface of the supporting plate 8.

[0027] Next, a description will be given about the lock lever 33 disposed above the feed lever 18 and a mechanism for driving the lock lever 33.

As seen in Fig. 4, the lock lever 33 has an engaging claw 33a at the tip of its one end and a stopper portion 33b at its other end. Intermediate portion of the lock lever 33 is pivotably supported, via a pin 39, by a support block 35 that is in turn fixed to the support plate 7. In Fig. 4, the support block 35 is shown with its front portion taken away to allow the lock lever 33 to be visible more easily. The engaging claw 33a of the lock lever 33 extends through a through-hole 18b formed in the feed lever 18, and a torsion spring (not shown) is provided on the pin 39 fixed to the support block 35. The lock lever 33 is normally biased, by that torsion spring, against the support block 35 in the counterclockwise direction of the figure and the stopper portion 33b of the thus-biased lock lever 33 abuts against a stopper portion 35a of the support block 35, so that the lock lever 33 in its free state is held in a posture or position where the end edge of the engaging claw 33a confronts the slit 8a of the supporting plate 8. In this state, the end edge of the engaging claw 33a of the lock lever 33 engages the center hole 3a of a predetermined one of the sequins S, to thereby immovably lock the continuous sequin strip 3. As will be later described in detail, the edge of the through-hole

18b in the feed lever 18 abuts against the lock lever 33, during rearward or retracting movement of the feed lever 18, to pivot the lock lever 33 in the clockwise direction against the counterclockwise biasing force of the torsion spring acting on the lock lever 33. In this way, the engaging claw 33a is moved upwardly to disengage the center hole 3a of the sequin S.

[0028] The support block 35 supporting the lock lever 33 is adjustable in its position, in the front-rear direction (i.e., feeding direction of the continuous sequin strip 3 on the supporting plate 8), relative to the support plate 7. Thus, the position at which the engaging claw 33a of the lock lever 33 engages the sequin S can be adjusted in accordance with the size of the sequin S. Note that the support plate 7 too is adjustable in its position, in the front-rear direction (i.e., feeding direction of the continuous sequin strip 3 on the supporting plate 8), relative to the mounting base 4.

[0029] In the instant embodiment of the embroidery sewing machine, the needle bar cases 2 of each of the machine heads includes nine needle bars 31, and the sequin sewing unit 1 is attached to the left side of each of the needle bar cases 2 as noted above. In sewing sequins, the leftmost needle bar 31 is selected, and the sequin sewing unit 1 descends into an operating state so that it sews sequins in conjunction with the needle bar 31.

[0030] The following paragraphs describe the sequin feeding operation performed in the embodiment of the present invention, with primary reference to Figs. 5 – 9 showing an example sequence of the sequin feeding operation.

Fig. 5 shows a state when one sequin feeding operation cycle has been completed. At this phase, the leading sequin S projects forward beyond the supporting plate 8, and the connecting portion S1 between the leading sequin S and the second sequin S is positioned immediately above (i.e., in alignment with) the cutting edge of the fixed cutter blade 8b. Also, at this phase, the engaging portion 18a of the feed lever 18 engages the above-mentioned second sequin S, and the engaging claw 33a of the lock lever 33 abuts against the center hole 3a of the third sequin S from the second sequin S, as noted above.

[0031] The feeder apparatus behaves as follows in response to descending movement of the needle bar 31.

First, as the needle bar 31 descends, a sewing needle 41 provided at the

lower end of the needle bar 31 (see Fig. 3) fits into the center hole 3a of the leading sequin S. Then, the movable cutter blade 27 is depressed by the descending movement of the needle clamp 32, so that the sequin strip 3 is cut in the connecting portion S1 of the leading sequin S and thus the leading sequin S is severed from the sequin strip 3. Then, the severed sequin S falls onto an embroidering fabric W (Fig. 3) with the sewing needle 41 still kept fit in the center hole 3a, after which the sequin S is sewn onto the fabric W through controlled movement of the embroidery frame holding the embroidering fabric W and vertical movement of the needle bar 31.

[0032] Then, the pivot lever 16 is pivoted in the clockwise direction via the motor 36, so that the feed lever 18 moves rearward as shown in Figs. 6 and 7. Fig. 6 shows a state immediately after disengagement, from the center hole 3a, of the engaging portion 18a of the feed lever 18, where (a) is a partly-sectional side view and (b) is a schematic plan view. During the disengagement, from the center hole 3a, of the engaging portion 18a, the engaging claw 33a of the lock lever 33 is kept fit in the center hole 3a, and thus, it is possible to reliably prevent the continuous sequin strip 3 from being undesirably displaced as the engaging portion 18a of the feed lever 18 disengages from the center hole 3a. Further, in the state shown in Fig. 6, the edge of the through-hole 18b of the feed lever 18 abuts against the lock lever 33. As the lock lever 18 further moves rearward in such a state, the lock lever 33 pivots in the clockwise direction against the biasing force of the torsion spring due to the engagement with the edge of the through-hole 18b of the feed lever 18 so that the engaging claw 33a of the lock lever 33 moves upwardly away from the sequin S and thereby disengages from the sequin's center hole 3a.

[0033] Fig. 7 the feed lever 18 having retracted to its rearwardmost position, where (a) is a partly-sectional side view and (b) is a schematic plan view. Immediately before reaching the state of Fig. 7, the engaging portion 18a of the feed lever 18 temporarily fits into the center hole 3a of the sequin S and then gets out of the center hole 3a. During a shit from the state of Fig. 6 to the state of Fig. 7, the continuous sequin strip 3, having been disengaged from the engaging claw 33a of the lock lever 33, can be prevented from being undesirably displaced rearward together with the retracting feed lever 18; this is by virtue of the springy

resilient force of the holding member 44.

[0034] After that, the pivot lever 16 is driven, by the reverse rotation of the motor 36, to pivot in the counterclockwise direction, so that the feed lever 18 moves forward up to the position shown in Fig. 5. Figs. 8 and 9 show variation in state of the feed lever 18 during such forward or advancing movement. Fig. 8 shows the feed lever 18 at a time point when the engaging portion 18a has engaged the center hole 3a, where (a) is a partly-sectional side view and (b) is a schematic plan view. Feeding of the continuous sequin strip 3 is carried out by forward movement of the engaging portion 18a engaging the center hole 3a as the feed lever 18 advances from that time point onward. Fig. 9 shows a time point when the edge of the through-hole 18b of the advancing feed lever 18 disengages the lock lever 33, where (a) is a partly-sectional side view and (b) is a schematic plan view. The lock lever 33, having been disengaged from the edge of the through-hole 18b of the feed lever 18, is caused to pivot in the counterclockwise direction by the resilient force of the torsion spring provided on the pin 39, upon which the engaging claw 33a of the lock lever 33 are brought into resilient contact with the upper surface of sequins S, as shown in Fig. 9. While the feed lever 18 is advancing further, the engaging claw 33a of the lock lever 33 slides on and relative to the upper surfaces of the sequins S. Once the feed lever 18 has reached the feed completion position as shown in Fig. 5, the engaging claw 33a of the lock lever 33 engages the center hole 3a of the sequin S.

[0035] When the motor 36 is in the non-energized or OFF state, such as when the power supply to the embroidery sewing machine is OFF, the pivot lever 16 is held in the feed completion position shown in Fig. 5, by virtue of the resilient force of the torsion spring 22 secured to the pivot lever 16, so that the lever 16 is held in abutment against the stopper 25. The motor 36 is a pulse motor that operates under open control, so that it will lose appropriate synchronization if an excessive force acts on the motor 36 during the feed control. For that reason, the motor 36 employed in the instant embodiment is temporarily deenergized when the feed lever 18 has reached the forwardmost position, i.e. when the pivot lever 16 has abutted against the stopper 25 upon completion of the feeding cycle. Thus, the motor 36 can be restored to the zero point without fail even when it has lost synchronization; in this way, it is possible to prevent accumulation of

positional displacement caused by the synchronization loss.

[0036] The following paragraphs describe an example manner in which the various components of the feeder apparatus are adjusted when the reel 5 has been replaced with another one so that the sequins S to be sewn onto the fabric are replaced with those of a different size. The adjustments of the components, as set forth in items (1) - (4) below, may be performed concurrently, or sequentially in any appropriate order.

[0037] (1) Adjustment of Feed Pitch:

In order to adjust the feed pitch, the screw 17 fastening the pivot lever 16 is loosened (see Fig. 3) so that the pivot lever 16 can be readily turned with a hand relative to the pivot shaft 15. Further, the stopper 25 is unlocked, and the continuous sequin strip 3 is let out from the reel onto the supporting plate 8 so that the leading sequin S of the strip 3 projects beyond the front end edge of the supporting plate 8 as indicated by the "feed completion position" as shown in (b) of Fig. 5. Then, the pivot lever 16 and feed lever 18 are moved with a hand to cause the engaging portion 18a of the feed lever 18 to engage the center hole 3a of the second sequin S from the leading end of the strip 3. Then, the stopper 25 is again locked and the screw 17 is tightened with the feed mechanism, including the pivot lever 16 and feed lever 18, adjusted into the "feed completion position" in accordance with the size of the sequins S.

[0038] (2) Adjustment of Lock Lever:

In order to adjust the lock lever 33, the support block 35 is unlocked. Position, in the front-rear direction, of the support block 35 is adjusted manually to adjust the inclination of the lock lever 33 so that the engaging claw 33a of the lock lever 33 engages the center hole 3a of a predetermined sequin S (third one from the sequin S engaged by the engaging portion 18a), as illustrated in Fig. 5, with the stopper portion 33b provided at the upper end of the lock lever 33 abutted against the stopper portion 35a of the support block 35. Thus, the support block 35 is again locked with the lock lever 33 positionally adjusted so that the engaging claw 33a of the lock lever 33 engages the center hone 3a of the predetermined sequin S as indicated by the "feed completion position" shown in (b) of Fig. 5.

[0039] (3) Positional Adjustment of Sequin's Center Hole Relative to Sewing

Needle Position:

Positional adjustment between the sewing needle 41 and the center hole 3a of the sequin S is carried out by adjusting the position of the support plate 7 relative to the mounting base 4. Because the support plate 7 is mounted to the mounting base 4 via the forward/rearward guide members, each lock (not shown) provided in connection with the guide members is brought into an unlocking position so as to allow the support plate 7 to be manually moved in the front-rear direction relative to the mounting base 4. Then, the support plate 7 is adjusted so that the center of the center hole 3a of the sequin S, having been delivered from the supporting plate 8 to a position where the connecting portion S1 aligns with the cutting edge of the fixed cutter blade 8b, aligns with the center of the sewing needle 41. Upon completion of the adjustment, the support plate 7 is locked and fixed to the mounting base 4.

[0040] (4) Replacement of Guide Section:

As necessary, the guide section 12, mounted on the bracket 11, may be replaced with another one that corresponds to the width of sequins of a continuous sequin strip newly set on the apparatus in place of the previous continuous sequin strip.

[0041] Lastly, a description will be given about an example manner in which the sequin S to be sewn has been changed to another sequin S' having an extremely small size. Figs. 10 and 11 show an example where extremely-small sequin S' of a 3 mm diameter are to be sewn, in which reference numeral 60 indicates a continuous sequin strip where extremely-small sequins S' are connected together (continuous extremely-small-sequin strip). In sewing such extremely-small sequin S' too, adjustments as set forth in items (1') – (4') below are carried out.

[0042] (1') Adjustment of Feed Pitch:

Feed pitch adjustment to be performed for sewing of extremely-small sequins S' is generally similar to the one to be performed when the sequins S to be sewn have been changed to sequins of an ordinary size as set forth above in item (1). In this case, however, if the engaging portion 18a of the feed lever 18 is caused to engage the center hole 61 of the second sequin S' from the leading end of the sequin strip 60 as with the sequin of the ordinary size, the engaging portion

18a of the feed lever 18 would interfere with the front edge of the slit 8a before it completely feeds out the leading sequin S', so that the connecting portion S'1 between the leading sequin S' and the second sequin S' can not be positioned in appropriate vertical alignment with the cutting edge of the fixed cutter blade 8b. Therefore, in sewing such extremely-small sequins S', the engaging portion 18a of the feed lever 18 is caused to engage the third sequin S' from the leading end of the sequin strip 60, but also the feed pitch is adjusted.

[0043] (2') Adjustment of Lock Lever:

Lock lever adjustment to be performed for sewing of extremely-small sequins S' is generally similar to the one to be performed when the sequins S to be sewn have been changed to sequins of an ordinary size as set forth above in item (2). However, because of the extremely small size, the engaging claw 33a of the lock lever 33 is caused to engage the center hole 61 of the fifth sequin S' from the sequin S' engaged by the engaging portion 18a of the feed lever 18.

[0044] (3') Positional Adjustment of Sequin's Center Hole Relative to Sewing Needle Position:

Positional adjustment of the center hole of the sequin relative to the sewing needle, performed for sewing of extremely-small sequins S', is generally similar to the one to be performed when the sequins S to be sewn have been changed to sequins of an ordinary size as set forth above in item (3). With each sequin S' having the 3 mm diameter, the center of the center hole 61 of the leading sequin S' of the sequin strip 60 is located 1.5 mm from the cutting edge of the fixed cutter blade 8b, and the sewing needle 41 drops to this location. Fig. 11 shows a state immediately before the needle clamp 32 at the lower end of the needle bar 31 abuts against the movable cutter blade 27 after the needle bar 31 descends to fit into the center hole 61 of the leading sequin S'. As clear from Fig. 11, even when the sewing needle 41 has descended to a position 1.5 mm short of the cutting edge of the fixed cutter blade 8b, the small-thickness end portion 27a of the movable cutter blade 27 can prevent the sewing needle 41 from hitting the cutter blade 27.

[0045] (4') Replacement of Guide Section:

For sewing of extremely-small sequins S', the guide section 12 provided on the bracket 11 is replaced with another one corresponding to the width of the changed extremely-small sequins S' in the same manner as stated in item (4)

above.

[0046] According to the instant embodiment, as set forth above, the center hole 61 of the sequin S' to be engaged by the engaging portion 18a of the feed lever 18 can be changed. Namely, the engaging portion 18a of the feed lever 18 can be adjusted to engage the center hole 61 of the third sequin S from the leading end of the sequin strip 60. Further, with the small-thickness end portion 27a formed on the movable cutter blade 27, the sewing needle 41 can be reliably prevented from hitting the cutter blade 27 even where the sewing needle 41 operates to sew the extremely-small sequin S' in proximity to the cutting edge of the fixed cutter blade 8b. In this way, the extremely-small sequin S' can be sewn appropriately.

[0047] In the above-described embodiment, the motor 36 is located in an upper area of the sewing apparatus, and the pivot lever 16 is driven by the motor 36 via a link. Alternatively, the pivot lever 16 may be driven directly by the output shaft 40 of the motor 36. Namely, the pivot shaft 15 and follower lever 20 may be dispensed with, and the motor 36 may be fixedly provided on the support plate 7 with the pivot lever 16 fixed to the output shaft 40.

Further, as described above, the preferred embodiment of the present invention is arranged to cause the locking by the lock lever 33 to be canceled during retracting movement of the feed lever 18 after the operational timing of Fig. 6. However, the present invention is not so limited, and the locking by the lock lever 33 may be canceled at least by the timing of Fig. 7 (i.e., until the feed lever 18 resumes its forward movement). In the case where the locking by the lock lever 33 is kept till the timing of Fig. 7, the particular holding member 44 can be dispensed with because the continuous sequin strip 3 can be held by the lock lever 33 during the rearward movement of the feed lever 18.

[0048] In the above-described embodiment, the mechanism for driving the lock lever 33 is arranged in such a manner that the counterclockwise pivoting of the lock lever 33 is effected via the torsion spring provided on the pin 39 of the support block 35 and the clockwise pivoting of the lock lever 33 is effected via the engagement between the edge of the through-hole 18b of the retracting feed lever 18 and the lock lever 33. However, the present invention is not so limited, and the driving mechanism may be constructed in any desired manner. For example, the spring used as the biasing means may be other than the torsion spring, and

the biasing means may include electrical or electronic or mechanical drive means other than a spring.

[0049] Further, according to the instant embodiment, the engaging claw 33a of the lock lever 33 has engaged the center hole 3a or 61 of the predetermined sequin S or S' when feeding-out of one sequin is completed. Thus, even when an unexpected pulling force acts on the predetermined sequin S or S' after the sewing needle 41 fits in the center hole 3a or 61 of the predetermined sequin S or S' to be sewn and before the predetermined sequin S or S' is cut off, the sequin strip 3 or 60 will not be let out, so that the sequin S or S' can be cut off without fail at the connecting portion S1 or S'1, so that the sequin S or S' can be reliably prevented from being cut off into an awkward shape.

[0050] Further, because the engaging portion 18a of the feed lever 18 and the engaging claw 33a of the lock lever 33 have engaged the center holes 3a or 61 of the predetermined sequins S or S' when feeding-out of one sequin is completed, the sequin strip 3 or 60 can be positionally controlled at two positions in its longitudinal direction (i.e., in the feeding direction). Thus, the sequins S or S' can be positionally adjusted in their width direction at least upon completion of each sequin feeding cycle. Therefore, no particular guide member has to be provided on the supporting plate 8 for positionally controlling the sequin strip 3 or 60.

Further, whereas, in the above-described embodiment, the needle clamp 32 is arranged to abut against the movable cutter blade 27 during the descending movement of the needle bar 31. However, the present invention is not so limited, and another suitable portion of the needle bar 31 or another suitable member movable in interlocked relation to the descending movement of the needle bar 31 may abut against and depress the movable cutter blade 27. Further, the movable cutter blade 27 is not limited to the illustrated construction or shape where the sequin-cutting portion (27a) has a smaller thickness than the abutment portion (27b), and the movable cutter blade 27 may be of any other desired construction or shape as long as it can attain the object of the present invention.

[0051] Note that the ordinary-size sequins S and extremely-small sequins S' to be handled in the present invention are not limited to the type where the needle-passing hole 3a or 61 is provided at the center (i.e., provided as a center

hole of the sequin); that is, the needle-passing hole 3a or 61 may be an eccentric hole provided off the center of the sequin S or S'. In such a case, if a minimum-radius portion of each sequin S or S' in a sequin strip 3 or 60 is positioned so as to lie from the offset hole 3a or 61 to the front (i.e., forward in the sequin feeding direction) edge of the sequin, then a maximum-radius portion of the sequin S or S' lies from the offset hole 3a or 61 to the rear (i.e., rearward in the sequin feeding direction) edge of the sequin, so that the maximum-radius portion of the sequin S or S' can be positioned in accurate vertical alignment with the width of cut of the movable cutter blade 27. In this way, the instant embodiment can sew a sequin of an even smaller size by appropriately changing the degree of eccentricity of the offset hole 3a or 61 in the sequin S or S' (while taking an appearance of the finished sequin into account) without changing the width of cut of the movable cutter blade 27 (i.e., thickness of the small-thickness distal end portion 27a). If the minimum diameter of an extremely-small sequin S' with the center hole 61 is 3 mm with the small-thickness distal end portion 27a of the movable cutter blade 27 having a predetermined thickness, a portion, corresponding to the width of cut, of the movable cutter blade 27 (i.e., rear portion, in the feeding direction, of the movable cutter blade 27) only has to have a 1.5 mm diameter. Thus, if 1.5 mm is secured as the maximum-radius portion to be located adjacent to the rear end in the feeding direction and the minimum-radius portion to be located adjacent to the front end in the feeding direction is set, for example, to 1.0 mm, it is possible to sew an even smaller sequin of a 2.5 mm diameter. Note that even where the movable cutter blade 27 does not have a thinned distal end portion, the instant embodiment can sew sequins S of much smaller sizes than those handled by the conventional sewing apparatus, by offsetting the needle-passing hole 3a of the sequins S in the aforementioned manner and positioning the maximum radius portion at a location corresponding to the width of cut of the movable cutter blade 27.